U.S. DEPARTMENT OF COMMERCE
National Technical Information Service
PB-300 609

Distribution of Phytoplankton in Missouri Lakes

(U.S.) Environmental Monitoring and Support Lab, Las Vegas, NV

Jun 79

United States
Environmental Protection
Agency

Environmental Monitoring
and Support Laboratory
P.O. Box 15027
Las Vegas NV 89114

EPA-600/3-79-065
June 1979

Research and Development

PB 300609

EPA

Distribution of Phytoplankton in Missouri Lakes

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

RESEARCH REPORTING SERIES

Research reports of the Office of Research and Development, U S. Environmental Protection Agency, have been grouped into nine series. These nine broad categories were established to facilitate further development and application of environmental technology. Elimination of traditional grouping was consciously planned to foster technology transfer and maximum interface in related fields. The nine series are:

1. Environmental Health Effects Research
2. Environmental Protection Technology
3. Ecological Research
4. Environmental Monitoring
5. Socioeconomic Environmental Studies
6. Scientific and Technical Assessment Reports (STAR)
7. Interagency Energy—Environment Research and Development
8. "Special" Reports
9. Miscellaneous Reports

This report has been assigned to the ECOLOGICAL RESEARCH series. This series describes research on the effects of pollution on humans,plant and animal species, and materials. Problems are assessed for their long-and short-term influences. Investigations include formations, transport, and pathway studies to determine the fate of pollutants and their effects. This work provided the technical basis for setting standards to minimize undesirable changes in living organisms in the aquatic, terrestrial, and atmospheric environments.

This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-600/3-79-065	2.
3. RECIPIENT'S ACCESSION NO. PB300609	
4. TITLE AND SUBTITLE DISTRIBUTION OF PHYTOPLANKTON IN MISSOURI LAKES	5. REPORT DATE June 1979
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) M.K. Morris, W.D. Taylor, L.R. Williams, S.C. Hern, V.W. Lambou, F.A. Morris	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Environmental Monitoring and Support Laboratory Office of Research and Development U.S. Environmental Protection Agency Las Vegas, NV 89114	10. PROGRAM ELEMENT NO. 1BD884
	11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Environmental Protection Agency-Las Vegas, NV Office of Research and Development Environmental Monitoring and Support Laboratory Las Vegas, NV 89114	13. TYPE OF REPORT AND PERIOD COVERED 03-15-74 to 11-20-74
	14. SPONSORING AGENCY CODE EPA/600/07

15. SUPPLEMENTARY NOTES

16. ABSTRACT

This is a data report presenting the species and abundance of phytoplankton in the 6 lakes sampled by the National Eutrophication Survey in the State of Missouri. Results from the calculation of several water quality indices are also included (Nygaard's Trophic State Index, Palmer's Organic Pollution Index, and species diversity and abundance indices).

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
*aquatic microbiology lakes *phytoplankton water quality	Missouri lake eutrophication Nygaard's trophic indices Palmer's organic pollution indices Species diversity and abundance indices	06 C, M 08 H 13 B

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report)	21. NO. OF PAGES
RELEASE TO PUBLIC	UNCLASSIFIED	37
	20. SECURITY CLASS (This page) UNCLASSIFIED	22. PRICE A03-A01

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

☆ U.S. GOVERNMENT PRINTING OFFICE: 1979-683-091/2106

EPA-600/3-79-065
June 1979

DISTRIBUTION OF PHYTOPLANKTON IN MISSOURI LAKES

by

M. K. Morris*, W. D. Taylor, L. R. Williams,
S. C. Hern, V. W. Lambou, and F. A. Morris*

Water and Land Quality Branch
Monitoring Operations Division
Environmental Monitoring and Support Laboratory
Las Vegas, Nevada 89114

*Department of Biological Sciences
University of Nevada, Las Vegas
Las Vegas, Nevada 89154

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
LAS VEGAS, NEVADA 89114

DISCLAIMER

This report has been reviewed by the Environmental Monitoring and Support Laboratory-Las Vegas, U.S. Environmental Protection Agency, and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

FOREWORD

Protection of the environment requires effective regulatory actions which are based on sound technical and scientific information. This information must include the quantitative description and linking of pollutant sources, transport mechanisms, interactions, and resulting effects on man and his environment. Because of the complexities involved, assessment of specific pollutants in the environment requires a total systems approach which transcends the media of air, water, and land. The Environmental Monitoring and Support Laboratory-Las Vegas contributes to the formation and enhancement of a sound monitoring data base for exposure assessment through programs designed to:

- develop and optimize systems and strategies for monitoring pollutants and their impact on the environment
- demonstrate new monitoring systems and technologies by applying them to fulfill special monitoring needs of the Agency's operating programs

This report presents the species and abundance of phytoplankton in the 6 lakes sampled by the National Eutrophication Survey in the State of Missouri, along with results from the calculation of several commonly used biological indices of water quality and community structure. These data can be used to biologically characterize the study lakes, and as baseline data for future investigations. This report was written for use by Federal, State, and local governmental agencies concerned with water quality analysis, monitoring, and or regulation. Private industry and individuals similarly involved with the biological aspects of water quality will find the document useful. For further information contact the Water and Land Quality Branch, Monitoring Operations Division.

George B. Morgan
Director
Environmental Monitoring and Support Laboratory
Las Vegas

CONTENTS

	Page
Foreword	iii
Introduction	1
Materials and Methods	2
Lake and Site Selection	2
Sample Preparation	2
Examination	3
Quality Control	4
Results	5
Nygaard's Trophic State Indices	5
Palmer's Organic Pollution Indices	5
Species Diversity and Abundance Indices	7
Species Occurrence and Abundance	9
Literature Cited	10
Appendix A. Phytoplankton Species list for the State of Missouri	11
Appendix B. Summary of Phytoplankton Data	14

Preceding page blank

INTRODUCTION

The collection and analysis of phytoplankton data were included in the National Eutrophication Survey in an effort to determine relationships between algal characteristics and trophic status of individual lakes.

During spring, summer, and fall of 1974, the Survey sampled 179 lakes in 10 States. Over 700 algal species and varieties were identified and enumerated from the 573 water samples examined.

This report presents the species and abundance of phytoplankton in the 6 lakes sampled in the State of Missouri (Table 1). The Nygaard's Trophic State (Nygaard 1949), Palmer's Organic Pollution (Palmer 1969), and species diversity and abundance indices are also included.

TABLE 1. LAKES SAMPLED IN THE STATE OF MISSOURI

STORET No.	Lake Name	County
2901	Clearwater Lake	Reynolds
2902	Pomme de Terre Reservoir	Polk, Hickory
2903	Stockton Reservoir	Dade, Polk, Cedar
2904	Lake Taneycomo	Taney
2905	Thomas Hill Reservoir	Macon, Randolph
2906	Wappepello Reservoir	Wayne, Butler

MATERIALS AND METHODS

LAKE AND SITE SELECTION

Lakes and reservoirs included in the Survey were selected through discussions with State water pollution agency personnel and U.S. Environmental Protection Agency Regional Offices (U.S. Environmental Protection Agency 1975). Screening and selection strongly emphasized lakes with actual or potential accelerated eutrophication problems. As a result, the selection was limited to lakes:

(1) impacted by one or more municipal sewage treatment plant outfalls either directly into the lake or by discharge to an inlet tributary within approximately 40 kilometers of the lake;

(2) 40 hectares or larger in size; and

(3) with a mean hydraulic retention time of at least 30 days.

Specific selection criteria were waived for some lakes of particular State interest.

Sampling sites for a lake were selected based on available information on lake morphometry, potential major sources of nutrient input, and on-site judgment of the field limnologist (U.S. Environmental Protection Agency 1975). Primary sampling sites were chosen to reflect the deepest portion of each major basin in a test lake. Where many basins were present, selection was guided by nutrient source information on hand. At each sampling site, a depth-integrated phytoplankton sample was taken. Depth-integrated samples were uniform mixtures of water from the surface to a depth of 15 feet (4.6 meters) or from the surface to the lower limit of the photic zone representing 1 percent of the incident light, whichever was greater. If the depth at the sampling site was less than 15 feet (4.6 meters), the sample was taken from just off the bottom to the surface. Normally, a lake was sampled three times in 1 year, providing information on spring, summer, and fall conditions.

SAMPLE PREPARATION

To preserve the sample 4 milliliters (ml) of Acid-Lugol's solution (Prescott 1970) were added to each 130-ml sample from each site at the time of collection. The samples were shipped to the Environmental Monitoring and Support Laboratory, Las Vegas, Nevada, where equal volumes from each site

were mixed to form two 130-ml composite samples for a given lake. One composite sample was put into storage and the other was used for the examination.

Prior to examination, the composite samples were concentrated by the settling method. Solids were allowed to settle for at least 24 hours prior to siphoning off the supernate. The volume of the removed supernate and the volume of the remaining concentrate were measured and concentrations determined. A small (8-ml) library subsample of the concentrate was then taken. The remaining concentrate was gently agitated to resuspend the plankton and poured into a capped, graduated test tube. If a preliminary examination of a sample indicated the need for a more concentrated sample, the contents of the test tube were further concentrated by repeating the settling method. Final concentrations varied from 15 to 40 times the original.

Permanent slides were prepared from concentrated samples after analysis was complete. A ring of clear Karo® corn syrup with phenol (a few crystals of phenol were added to each 100 ml of syrup) was placed on a glass slide. A drop of superconcentrate from the bottom of the test tube was placed in the ring. This solution was thoroughly mixed and topped with a coverglass. After the syrup at the edges of the coverglass had hardened, the excess was scraped away and the mount was sealed with clear fingernail polish. Permanent diatom slides were prepared by drying sample material on a coverglass, heating in a muffle furnace at 400° C for 45 minutes, and mounting in Hyrax®. Finally, the mounts were sealed with clear fingernail polish.

Backup samples, library samples, permanent sample slides, and Hyrax®-mounted diatom slides are being stored and maintained at the Environmental Monitoring and Support Laboratory-Las Vegas.

EXAMINATION

The phytoplankton samples were examined with the aid of binocular compound microscopes. A preliminary examination was performed to precisely identify and list all forms encountered. The length of this examination varied depending on the complexity of the sample. An attempt was made to find and identify all of the forms present in each sample. Often forms were observed which could not be identified to species or to genus. Abbreviated descriptions were used to keep a record of these forms (e.g., lunate cell, blue-green filament, Navicula #1). Diatom slides were examined using a standard light microscope. If greater resolution was essential to accurately identify the diatoms, a phase-contrast microscope was used.

After the species list was compiled, phytoplankton were enumerated using a Neubauer Counting Chamber with a 40X objective lens and a 10X ocular lens. All forms within each field were counted. The count was continued until a minimum of 100 fields had been viewed, or until the dominant form had been observed a minimum of 100 times.

®Registered trademark

QUALITY CONTROL

Project phycologists performed internal quality control intercomparisons regularly on 7 percent of the species identification and counts. Although an individual had primary responsibility for analyzing a sample, taxonomic problems were discussed among the phycologists.

Additional quality control checks were performed on the Survey samples by Dr. G. W. Prescott of the University of Montana at the rate of 5 percent. Quality control checks were made on 75 percent of these samples to verify species identifications while checks were made on the remaining 25 percent of the samples to verify genus counts. Presently, the agreement between quality control checks for species identification and genus enumerations is satisfactory.

RESULTS

A phytoplankton species list for the State is presented in Appendix A. Appendix B summarizes all of the phytoplankton data collected from the State by the Survey. The latter is organized by lake, and includes an alphabetical phytoplankton species list with concentrations for individual species given by sampling date. Results from the application of several indices are presented (Nygaard's Trophic State, Palmer's Organic Pollution, and species diversity and abundance). Each lake has been assigned a four-digit STORET number. (STORET (STOrage and RETrieval) is the U.S. Environmental Protection Agency's computer system which processes and maintains water quality data.) The first two digits of the STORET number identify the State; the last two digits identify the lake.

NYGAARD'S TROPHIC STATE INDICES

Five indices devised by Nygaard (1949) were proposed under the assumption that certain algal groups are indicative of levels of nutrient enrichment. These indices were calculated in order to aid in determining the surveyed lakes' trophic status. As a general rule, Cyanophyta, Euglenophyta, centric diatoms, and members of the Chlorococcales are found in waters that are eutrophic (rich in nutrients), while desmids and many pennate diatoms generally cannot tolerate high nutrient levels and so are found in oligotrophic waters (poor in nutrients).

In applying the indices to the Survey data, the number of taxa in each major group was determined from the species list for each sample. The ratios of these groups give numerical values which can be used as a biological index of water richness. The five indices and the ranges of values established for Danish lakes by Nygaard for each trophic state are presented in Table 2. The appropriate symbol, (E) eutrophic and (O) oligotrophic, follows each calculated value in the tables in Appendix B. A question mark (?) following a calculated value in these tables was entered when that value was within the range of both classifications.

PALMER'S ORGANIC POLLUTION INDICES

Palmer (1969) analyzed reports from 165 authors and developed algal pollution indices for use in rating water samples with high organic pollution. Two lists of organic-pollution-tolerant forms were prepared, one containing 20 genera, the other, 20 species (Tables 3 and 4). Each form was assigned a pollution index number ranging from 1 for moderately tolerant forms to 6 for

TABLE 2. NYGAARD'S TROPHIC STATE INDICES ADAPTED FROM HUTCHINSON (1967)

Index	Calculation	Oligotrophic	Eutrophic
Myxophycean	$\frac{\text{Myxophyceae}}{\text{Desmideae}}$	0.0-0.4	0.1-3.0
Chlorophycean	$\frac{\text{Chlorococcales}}{\text{Desmideae}}$	0.0-0.7	0.2-9.0
Diatom	$\frac{\text{Centric Diatoms}}{\text{Pennate Diatoms}}$	0.0-0.3	0.0-1.75
Euglenophyte	$\frac{\text{Euglenophyta}}{\text{Myxophyceae + Chlorococcales}}$	0.0-0.2	0.0-1.0
Compound	$\frac{\text{Myxophyceae + Chlorococcales + Centric Diatoms + Euglenophyta}}{\text{Desmideae}}$	0.0-1.0	1.2-25

TABLE 3. ALGAL GENUS POLLUTION INDEX (Palmer 1969)

Genus	Pollution Index
Anacystis	1
Ankistrodesmus	2
Chlamydomonas	4
Chlorella	3
Closterium	1
Cyclotella	1
Euglena	5
Gomphonema	1
Lepocinclis	1
Melosira	1
Micractinium	1
Navicula	3
Nitzschia	3
Oscillatoria	5
Pandorina	1
Phacus	2
Phormidium	1
Scenedesmus	4
Stigeoclonium	2
Synedra	2

TABLE 4. ALGAL SPECIES POLLUTION INDEX (Palmer 1969)

Species	Pollution Index
Ankistrodesmus falcatus	3
Arthrospira jenneri	2
Chlorella vulgaris	2
Cyclotella meneghiniana	2
Euglena gracilis	1
Euglena viridis	6
Gomphonema parvulum	1
Melosira varians	2
Navicula cryptocephala	1
Nitzschia acicularis	1
Nitzschia palea	5
Oscillatoria chlorina	2
Oscillatoria limosa	4
Oscillatoria princeps	1
Oscillatoria putrida	1
Oscillatoria tenuis	4
Pandorina morum	3
Scenedesmus quadricauda	4
Stigeoclonium tenue	3
Synedra ulna	3

extremely tolerant forms. Palmer based the index numbers on occurrence records and/or where emphasized by the authors as being especially tolerant of organic pollution.

In analyzing a water sample, any of the 20 genera or species of algae present in concentrations of 50 per milliliter or more are recorded. The pollution index numbers of the algae present are totaled, providing a genus score and a species score. Palmer determined that a score of 20 or more for either index can be taken as evidence of high organic pollution, while a score of 15 to 19 is taken as probable evidence of high organic pollution. Lower figures suggest that the organic pollution of the sample is not high, that the sample is not representative, or that some substance or factor interfering with algal persistence is present and active.

SPECIES DIVERSITY AND ABUNDANCE INDICES

"Information content" of biological samples is being used commonly by biologists as a measure of diversity. Diversity in this connection means the degree of uncertainty attached to the specific identity of any randomly selected individual. The greater the number of taxa and the more equal their proportions, the greater the uncertainty, and hence, the diversity (Pielou 1966). There are several methods of measuring diversity, e.g., the formulas given by Brillouin (1962) and Shannon and Weaver (1963). The method which is appropriate depends on the type of biological sample on hand.

Pielou (1966) classifies the types of biological samples and gives the measure of diversity appropriate for each type. The Survey phytoplankton samples are what she classifies as larger samples (collections in Pielou's terminology) from which random subsamples can be drawn. According to Pielou, the average diversity per individual (H) for these types of samples can be estimated from the Shannon-Wiener formula (Shannon and Weaver 1963):

$$H = -\sum_{i=1}^{S} P_i \log_x P_i$$

where P is the proportion of the ith taxon in the sample, which is calculated from n_i/N; n_i is the number of individuals per milliliter of the ith taxon; N is the total number of individuals per ml; and S is the total number of taxa. However, Basharin (1959) and Pielou (1966) have pointed out that H calculated from the subsample is a biased estimator of the sample H, and if this bias is to be accounted for, we must know the total number of taxa present in the sample since the magnitude of this bias depends on it.

Pielou (1966) suggests that if the number of taxa in the subsample falls only slightly short of the number in the larger sample, no appreciable error will result in considering S, estimated from the subsample, as being equal to the sample value. Even though considerable effort was made to find and identify all taxa, the Survey samples undoubtedly contain a fair number of rare phytoplankton taxa which were not encountered.

In the Shannon-Wiener formula, an increase in the number of taxa and/or an increase in the evenness of the distribution of individuals among taxa will increase the average diversity per individual from its minimal value of zero. Sager and Hasler (1969) found that the richness of taxa was of minor importance in determination of average diversity per individual for phytoplankton and they concluded that phytoplankton taxa in excess of the 10 to 15 most abundant ones have little effect on H. This was verified by our own calculations. Our counts are in number per milliliter and since logarithms to the base 2 were used in our calculations, H is expressed in units of bits per individual. When individuals of a taxon were so rare that they were not counted, a value of 1/130 per milliliter or 0.008 per milliliter was used in the calculations since at least one individual of the taxon must have been present in the collection.

A Survey sample for a given lake represents a composite of all phytoplankton collected at different sampling sites on the lake during a given sampling period. Since the number of samples (M) making up a composite is a function of both the complexity of the lake sampled and its size, it should affect the richness-of-taxa component of the diversity of our phytoplankton collections. The maximum diversity (MaxH) (i.e., when the individuals are distributed among the taxa as evenly as possible) was estimated from $\log_2 S$ (Pielou 1966), while the minimum diversity (MinH), was estimated from the formula:

$$\text{MinH} = -\frac{S-1}{N}\log_2\frac{1}{N} - \frac{N-(S-1)}{N}\log_2\frac{N-(S-1)}{N}$$

given by Zand (1976). The total diversity (D) was calculated from HN (Pielou 1966). Also given in Appendix B are L (the mean number of individuals per taxa per milliliter) and K (the number of individuals per milliliter of the most abundant taxon in the sample).

The evenness component of diversity (J) was estimated from H/MaxH (Pielou 1966). Relative evenness (RJ) was calculated from the formula:

$$RJ = \frac{H-\text{MinH}}{\text{MaxH}-\text{MinH}}$$

given by Zand (1976). Zand suggests that RJ be used as a substitute for both J and the redundancy expression given by Wilhm and Dorris (1968). As pointed out by Zand, the redundancy expression given by Wilhm and Dorris does not properly express what it is intended to show, i.e., the position of H in the range between MaxH and MinH. RJ may range from 0 to 1; being 1 for the most even samples and 0 for the least even samples.

Zand (1976) suggests that diversity indices be expressed in units of "sits", i.e., in logarithms to base S (where S is the total number of taxa in the sample) instead of in "bits", i.e., in logarithms to base 2. Zand points out that the diversity index in sits per individual is a normalized number ranging from 1 for the most evenly distributed samples to 0 for the least evenly distributed samples. Also, it can be used to compare different samples, independent of the number of taxa in each. The diversity in bits per

individual should not be used in direct comparisons involving various samples which have different numbers of taxa. Since MaxH equals log S, the expression in sits is equal to $\log_S S$, or 1. Therefore diversity in sits per individual is numerically equivalent to J, the evenness component for the Shannon-Wiener formula.

SPECIES OCCURRENCE AND ABUNDANCE

The alphabetic phytoplankton species list for each lake, presented in Appendix B, gives the concentrations of individual species by sampling date. Concentrations are in cells, colonies, or filaments (CEL, COL, FIL) per milliliter. An "X" after a species name indicates that the species identified in the preliminary examination was in such a low concentration that it did not appear in the count. A blank space indicates that the organism was not found in the sample collected on that date. Column S is used to designate the examiner's subjective opinion of the five dominant taxa in a sample, based upon relative size and concentration of the organism. The percent column (%C) presents, by abundance, the percentage composition of each taxon.

LITERATURE CITED

Basharin, G. P. 1959. On a statistical estimate for the entropy of a sequence of independent random variables, pp. 333-336. In: Theory of Probability and Its Applications (translation of "Teoriya Veroyatnosei i ee Premeneniya"). N. Artin (ed). 4. Society for Industrial and Applied Mathematics, Philadelphia.

Brillouin, L. 1962. Science and Information Theory (2nd ed.). Academic Press, New York. 351 pp.

Hutchinson, G. E. 1967. A Treatise on Limnology. II. Introduction to Lake Biology and the Limnoplankton. John Wiley and Sons, Inc., New York. 1,115 pp.

Nygaard, G. 1949. Hydrobiological studies of some Danish ponds and lakes. II. (K danske Vidensk. Selsk.) Biol. Sci. 7:293.

Palmer, C. M. 1969. A composite rating of algae tolerating organic pollution. J. Phycol. 5:78-82.

Pielou, E. C. 1966. The measurement of diversity in different types of biological collections. J. Theor. Biol. 13:131-144.

Prescott, G. W. 1970. How to Know the Freshwater Algae. William C. Brown Company, Dubuque. 348 pp.

Sager, P. E., and A. D. Hasler. 1969. Species diversity in lacustrine phytoplankton. I. The components of the index of diversity from Shannon's formula. Amer. Natur. 103(929):51-59.

Shannon, C. E., and W. Weaver. 1963. The Mathematical Theory of Communication. University of Illinois Press, Urbana. 117 pp.

U.S. Environmental Protection Agency. 1975. National Eutrophication Survey Methods 1973-1976. Working Paper No. 175. Environmental Monitoring and Support Laboratory, Las Vegas, Nevada, and Corvallis Environmental Research Laboratory, Corvallis, Oregon. 91 pp.

Wilhm, V. L., and T. C. Dorris. 1968. Biological parameters for water quality criteria. Bio-Science. 18:477.

Zand, S. M. 1976. Indexes associated with information theory in water quality. J. Water Pollut. Contr. Fed. 48(8):2026-2031.

APPENDIX A

PHYTOPLANKTON SPECIES LIST FOR THE STATE OF MISSOURI

Achnanthes microcephala
Actinastrum gracilimum
Anabaena sp.
Ankistrodesmus falcatus
Anksitrodesmus falcatus
v. *acicularis*
Ankistrodesmus falcatus
v. *mirabilis*
Aphanizomenon flos-aquae
Aphanothece sp.
Asterionella formosa
Asterionella formosa
v. *gracillima*
Carteria sp.
Ceratium hirundinella
f. *brachyceras*
Ceratium hirundinella
f. *furcoides*
Chlamydomonas sp.
Chlorogonium sp.
Chroomonas acuta
Closterium sp.
Cocconeis sp.
Coelastrum cambricum
Coelastrum microporum
Coelastrum reticulatum
Coelastrum reticulatum
v. *polychordon*
Coelastrum sphaericum
Coelosphaerium pallidum
Cosmarium clepsydra
v. *nanum*
Crucigenia apiculata
crucigenia quadrata
Crucigenia tetrapedia
Cryptomonas erosa
Cryptomonas erosa
v. *reflexa*
Cryptomonas reflexa
Cyclotella meneghiniana
Cyclotella stelligera
Cymatopleura solea
Cymbella cymbiformis
Cymbella turgigula
Dactylococcopsis sp.
Diatoma vulgare
Dictyosphaerium pulchellum
Dinobryon bavaricum
Dinobryon divergens
Dinobryon sociale
Euastrum denticulatum
Euglena acus
Euglena ehrenbergii
Euglena gracilis
Euglena oxyuris
v. *minor*
Euglena subehrenbergii
Euglena tripteris
Fragilaria crotonensis
Franceia sp.
Glenodinium aciculiferum
Glenodinium gymnodinium
Glenodinium gymnodinium
v. *biscutelliforme*
Glenodinium oculatum
Glenodinium penardiforme
Gomphonema olivaceum
Gomphosphaeria
Gymnodinium albulum
Gyrosigma sp.
Hantzschia amphioxys
Kirchneriella lunaris
Lagerheimia chodati ?
Lagerheimia quadriseta ?
Lepocinclis sp.
Lyngbya sp.
Mallomonas sp.
Melosira distans
Melosira granulata
Melosira granulata
v. *angustissima*
Melosira varians
Meridion circulare
Merismopedia glauca
Merismopedia minima
Merismopedia punctata
Merismopedia tenuissima
Mesostigma viridis
Micractinium ? sp.
Microcystis aeruginosa
Microcystis incerta
Mougeotia sp.
Navicula salinarum
Nitzschia acicularis
Nitzschia filiformis
Nitzschia tryblionella
v. *debilis*
Oocystis sp.
Oscillatoria limnetica
Pandorina morum

Pediastrum biradiatum
Pediastrum biradiatum
v. *longecornutum*
Pediastrum duplex
v. *reticulatum*
Pediastrum simplex
Pediastrum simplex
v. *duodenarium*
Pediastrum tetras
v. *tetraodon*
Peridinium aciculiferum ?
Peridinium inconspicuum
Peridinium quadridens
Phacus acuminatus
Phacus caudatus
Phacus curvicauda
Phacus longicauda
Phacus megalopsis
Raphidiopsis curvata
Scenedesmus abundans
Scenedesmus acuminatus
Scenedesmus arcuatus
Scenedesmus bicaudatus
Scenedesmus bijuga
Scenedesmus denticulatus
Scenedesmus denticulatus
v. *linearis*
Scenedesmus dimorphus
Scenedesmus intermedius
Scenedesmus intermedius
v. *bicaudatas*
Scenedesmus quadricauda
Scenedesmus quadricauda
v. *quadrispina*

Schroederia setigera
Skeletonema potamos
Sphaerocystis schroeteri
Staurastrum sp.
Stephanodiscus astraea
v. *minutula*
Stephanodiscus niagarae
Surirella angusta
Synedra acus
Synedra capitata
Synedra delicatissima
Synedra delicatissima
v. *angustissima*
Synedra ulna
Tetraedron constrictum
Tetraedron gracile
Tetraedron limneticum
Tetraedron minimum
Tetraedron minimum
v. *scrobiculatum*
Tetraedron muticum
Tetraedron trigonum
v. *gracile*
Tetraedron trigonum
v. *papilliferum*
Tetrastrum staurogeniaeforme
Trachelomonas fluviatilis
Trachelomonas hispida
Trachelomonas intermedia
Trachelomonas jaculata
Trachelomonas volvocina
Treubaria setigerum
Treubaria triappendiculata

APPENDIX B. SUMMARY OF PHYTOPLANKTON DATA

This appendix was generated by computer. Because it was only possible to use upper case letters in the printout, all scientific names are printed in upper case and are not italicized.

The alphabetic phytoplankton lists include taxa without species names (e.g., EUNOTIA, EUNOTIA #1, FLAGELLATE, FLAGELLATES, MICROCYSTIS INCERTA ?, CHLOROPHYTAN COCCOID CELLED COLONY). When species determinations were not possible, symbols or descriptive phrases were used to separate taxa for enumeration purposes. Each name on a list, however, represents a unique species different from any other name on the same list, unless otherwise noted, for counting purposes.

Numbers were used to separate unidentified species of the same genus. A generic name listed alone is also a unique species. A question mark (?) is placed immediately after the portion of a name which was assigned with uncertainty. Numbered, questioned, or otherwise designated taxa were established on a lake-by-lake basis; therefore NAVICULA #2 from lake A cannot be compared to NAVICULA #2 from lake B. Pluralized categories (e.g., FLAGELLATES, CENTRIC DIATOMS, SPP.) were used for counting purposes when taxa could not be properly differentiated on the counting chamber.

ERRATA

Minimum and evenness are misspelled in the computer printout of the species diversity and abundance indices data.

LAKE NAME: CLEARWATER LAKE
STORET NUMBER: 2901

HYGAARD TROPHIC STATE INDICES

DATE	04 09 74	06 18 74	10 08 74
MYXOPHYCEAN	2.00 E	2.00 E	0/01 D
CHLOROPHYCEAN	2.00 E	7.00 E	4.00 E
EUGLENOPHYTE	0.25 E	0.56 E	1.75 E
DIATOM	0.50 E	0.44 E	0.25 ?
COMPOUND	9.00 E	18.0 E	12.0 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	04 09 74	06 18 74	10 08 74
GENUS	05	02	01
SPECIES	00	00	00

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		04 09 74	06 18 74	10 08 74
AVERAGE DIVERSITY	H	2.79	2.64	2.12
NUMBER OF TAXA	S	20.00	35.00	26.00
NUMBER OF SAMPLES COMPOSITED	M	3.00	3.00	3.00
MAXIMUM DIVERSITY	MAXH	4.32	5.13	4.70
MINIMUM DIVERSITY	MINH	0.21	0.33	0.52
TOTAL DIVERSITY	D	2843.01	3144.24	1049.40
TOTAL NUMBER OF INDIVIDUALS/ML	N	1019.00	1191.00	495.00
EVENESS COMPONENT	J	0.65	0.51	0.45
RELATIVE EVENESS	RJ	0.63	0.49	0.39
MEAN NUMBER OF INDIVIDUALS/TAXA	L	50.95	34.03	19.04
NUMBER/ML OF MOST ABUNDANT TAXON	K	266.00	428.00	165.00

LAKE NAME: CLEARWATER LAKE CONTINUED
STORET NUMBER: 2901

TAXA	FORM	04 09 74 BS	04 09 74 %C	04 09 74 ALGAL UNITS PER ML	06 18 74 BS	06 18 74 %C	06 18 74 ALGAL UNITS PER ML	10 09 74 BS	10 09 74 %C	10 09 74 ALGAL UNITS PER ML
ANABAENA	FIL		X							
ANKISTRODESMUS	CEL		X							
ANKISTRODESMUS FALCATUS	CEL						X			
ANKISTRODESMUS FALCATUS V. ACICULARIS	CEL				4.0		40		X	
ASTERIONELLA FORMOSA	CEL		X				X			
CENTRIC DIATOM	CEL			140	8.0		95			
CERATIUM HIRUNDINELLA F. FURCOIDES	CEL								X	
CHLOROPHYTAN COCCOID CELLED COLONY	COL								X	
CHROOMONAS ACUTA	CEL	12	20.1	260	13	35.9	420			
CLOSTERIUM #1	CEL								X	
CLOSTERIUM #2	CEL						X			
COCCOID CELL	CEL							15	11.1	55
COELASTRUM CAMBRICUM	COL								X	
COELASTRUM RETICULATUM V. POLYCHORDUM	COL						X			
COSMARIUM	CEL		X							
CRYPTOMONAS	CEL	11	17.4	177						
CRYPTOMONAS EROSA	CEL				12	16.0	390	12	33.3	165
CRYPTOMONAS REFLEXA	CEL								X	
CYCLOTELLA STELLIGERA	CEL	14	13.1	133						
CYMBELLA	CEL						X		X	
CYMBELLA CYMBIFORMIS	CEL		X							
CYMBELLA TUMIDULA	CEL		X							
DIATOMA VULGARE	CEL						X			
DINOBRYON	CEL						X			
EUGLENA	CEL		X	151	4.0		40		X	
EUGLENA IRIPIENIS	CEL								X	
FRAGILARIA CRUTUNENSIS	CEL						X			
GLENODINIUM UCULATUM	CEL								X	
GLENODINIUM PENARDIFORME	CEL						X		X	
GYROSIGMA ?	CEL						X			
LEPOCINCLIS	CEL								X	
MELOSIRA DISTANS	CEL	13	13.1	133			X			
MELOSIRA GRANULATA	CEL		4.3	44			X	13	33.3	165
MELOSIRA VARIANS	CEL		X				X			
MERIDION CIRCULARE	CEL		X							
MICROCYSTIS INCERTA	COL				4.0		40			
NOUGEOTIA	FIL						X			
NAVICULA	CEL								X	
NITZSCHIA	CEL								X	
NITZSCHIA #1	CEL		8.7	89						
NITZSCHIA #2	CEL	14	13.1	133						
NITZSCHIA #3	CEL						X			
NOCYSTIS	COL						X			
OSCILLATORIA	FIL		X				X			
PEDIASTRUM SIMPLEX	COL								X	
PEDIASTRUM TETRAS V. TETRAODON	COL								X	
PERIDINIUM INCONSPICUUM	CEL				4.0		40	13	11.1	55
PERIDINIUM QUADRIDENS	CEL						X		X	
PHACUS CAUDATUS	CEL								X	
PHACUS CURVICAUDA	CEL						X			
PHACUS LONGICAUDA	CEL								X	
PHACUS MEGALOPSIS	CEL						X			
SCENEDESMUS BIJUGA	COL						X			
SCENEDESMUS DIMORPHUS	COL				4.0		40			
SCENEDESMUS QUADRICAUDA	COL		X				X			
SYNEDRA	CEL			11	20.0		230			
SYNEDRA #1	CEL	4.3		44						
SYNEDRA CAPITATA	CEL						X			
SYNEDRA DELICATISSIMA V. ANGUSTISSIMA	CEL		X							
SYNEDRA ULNA	CEL						X		X	
TRACHELOMONAS FLUVIATILIS	CEL							14	11.1	55
TRACHELOMONAS HISPIDA	CEL								X	
TRACHELOMONAS INTERMEDIA	CEL									
TRACHELOMONAS JACULATA	CEL						X			
TOTAL				1039			1191			495

LAKE NAME: PONME DE TERRE RES.
STORET NUMBER: 2902

NYGAARD TROPHIC STATE INDICES

DATE	04 08 74	06 20 74	10 06 74
MYXOPHYCEAN	0/01 D	2.00 E	2.50 E
CHLOROPHYCEAN	7.00 E	10.5 E	7.50 E
EUGLENOPHYTE	0.14 ?	0.12 ?	0.05 ?
DIATOM	1.40 E	1.25 E	1.33 E
COMPOUND	15.0 E	16.5 E	12.5 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	04 08 74	06 20 74	10 06 74
GENUS	10	07	09
SPECIES	00	00	00

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		04 08 74	06 20 74	10 06 74
AVERAGE DIVERSITY	H	2.85	3.62	3.27
NUMBER OF TAXA	S	25.00	49.00	33.00
NUMBER OF SAMPLES COMPOSITED	M	4.00	5.00	5.00
MAXIMUM DIVERSITY	MAXH	4.64	5.61	5.04
MINUMUM DIVERSITY	MINH	0.09	0.14	0.13
TOTAL DIVERSITY	D	10593.45	18255.78	10437.84
TOTAL NUMBER OF INDIVIDUALS/ML	N	3717.00	4779.00	3192.00
EVENESS COMPONENT	J	0.61	0.68	0.65
RELATIVE EVENESS	RJ	0.61	0.68	0.64
MEAN NUMBER OF INDIVIDUALS/TAXA	L	148.68	97.53	96.73
NUMBER/ML OF MOST ABUNDANT TAXON	K	1095.00	887.00	723.00

LAKE NAME: POINTE DE TERRE BLS.
STORET NUMBER: 2902

CONTINUED

TAXA	FORM	04 08 74 IS	04 08 74 SC	04 08 74 ALGAL UNITS PER ML	06 20 74 IS	06 20 74 SC	06 20 74 ALGAL UNITS PER ML	10 06 74 IS	10 06 74 SC	10 06 74 ALGAL UNITS PER ML
ANABAENA	FIL					X				
ANKISTRODESMUS	CEL				1	1.0I	49	1	1.3I	43
ANKISTRODESMUS FALCATUS	CEL	1	1.3I	48						
ANKISTRODESMUS FALCATUS V. ACICULARIS	CEL			X						
APHANIZOMENON FLOS-AQUAE	FIL				13	10.6I	887			
ASTERIONELLA FORMOSA	CEL	1	1.3I	48			X			
CAPTERIA	CEL				13	10.3I	493			
CENTRIC DIATOMS	CEL				15	6.2I	296	1	5.3I	170
CERATIUM HIRUNDINELLA F. BRACHYCERAS	CEL				1	1.0I	49			
CHLAMYDOMONAS	CEL	1	6.4I	238						
CHROOMONAS ACUTA	CEL	1	3.8I	143	1	8.2I	394	35	10.7I	340
CLOSTERIUM	CEL				1	1.0I	49			
CLOSTERIUM #1	CEL			X						
CLOSTERIUM #2	CEL									X
COELASTRUM MICROPORUM	COL					X				X
COELASTRUM SPHAERICUM	COL				1	1.0I	49			
COSMARIUM	CEL				1	2.1I	99			
CRUCIGENIA APICULATA	COL					X		1	1.3I	43
CRUCIGENIA QUADRATA	COL					X				
CRUCIGENIA TETRAPEDIA	COL				1	1.0I	49	14	6.7I	233
CRYPTOMONAS	CEL	15	3.8I	143	14	9.3I	444			X
CRYPTOMONAS EROSA V. REFLEXA	CEL	1	5.1I	191						X
CRYPTOMONAS REFLEXA	CEL							13	2.7I	85
CRYPTOMONAS SPP.	CEL				12	18.6I	887			
CYCLOTELLA	CEL									X
CYCLOTELLA STELLIGERA	CEL							1	18.7I	596
DACTYLOCOCCOPSIS	COL			X			X			
DICTYOSPHAERIUM PULCHELLUM	CEL									X
EUASTRUM	CEL	12	9.0I	333			X			
EUGLENA	CEL				1	1.0I	49			
GLENODINIUM GYMNODINIUM	CEL						X			
GLENODINIUM OCULATUM	CEL									
GYROSTIGMA	CEL			X						
HANTZSCHIA AMPHIOXYS	CEL			X						
KIRCHNERIELLA	CEL									X
LAGERHEIMIA	CEL						X	1	1.3I	43
LAGERHEIMIA QUADRISETA ?	CEL									X
MALLOMONAS	CEL						X			
MELOSIRA DISTANS	CEL	14	11.5I	429	1	2.1I	99	12	16.0I	510
MELOSIRA GRANULATA	CEL	11	29.9I	1095			X	11	22.7I	723
MELOSIRA GRANULATA V. ANGUSTISSIMA	CEL			X						
MELOSIRA VARIANS	CEL			X						
MERISMOPEDIA TENUISSIMA	COL									X
MESOSTIGMA VIRIDIS	CEL				1	2.1I	99			
MICRACTINIUM ?	CEL						X			
MICROCYSTIS AERUGINOSA	COL						X			
MICROCYSTIS INCERTA	COL				1	2.1I	99	1	4.0I	128
NITZSCHIA SPP.	CEL							1	2.7I	85
OSCILLATORIA LIMNETICA	FIL									X
PANDORINA MORUM	COL						X			
PEDIASTRUM BIRADIATUM	COL				1	1.0I	49			
PEDIASTRUM SIMPLEX V. DUODENARIUM	COL			X			X			X
PEDIASTRUM TETRAS V. TETRADON	COL						X			
PENNATE DIATOM	CEL	1	1.3I	48	1	4.1I	197			
PERIDINIUM QUADRIDENS	CEL				1	1.0I	49			
PHACUS	CEL						X			X
RAPHIDIOPSIS CURVATA	FIL							1	1.3I	43
SCENEDESMUS ACUMINATUS	COL			X						
SCENEDESMUS ARCUATUS	COL				1	1.0I	49			
SCENEDESMUS BIJUGA	COL				1	1.0I	49			
SCENEDESMUS DENTICULATUS V. LINEARIS	COL			X						X
SCENEDESMUS DIMORPHUS	COL						X	1	2.7I	85
SCENEDESMUS INTERMEDIUS V. BICAUDATUS	COL							1	2.7I	85
SCENEDESMUS QUADRICAUDA	COL			X	1	1.0I	49			X
SCHROEDERIA SETIGERA	CEL						X			
SKELETONEMA POTAMOS	CEL			X						
STEPHANODISCUS ASTRAEA V. MINUTULA	CEL	13	25.6I	953						
STEPHANODISCUS NIAGARAE	CEL	1	1.3I	48			X			
SURIRELLA	CEL						X			
SYNEDRA DELICATISSIMA	CEL	1			1	1.0I	49	1		X

LAKE NAME: PUMME DE TERRE RES. CONTINUED
STORET NUMBER: 2902

TAXA	FORM	04 08 74 IS	04 08 74 %C	04 08 74 ALGAL UNITS PER ML	06 20 74 IS	06 20 74 %C	06 20 74 ALGAL UNITS PER ML	10 06 74 IS	10 06 74 %C	10 06 74 ALGAL UNITS PER ML
SYNEDRA DELICATISSIMA										
V. ANGUSTISSIMA	CEL			X						
TETRAEDRON MINIMUM										
V. SCROBICULATUM	CEL									
TETRAEDRON MUTICUM	CEL				1.08	49				X
TETRASTRUM STAUROGENIAEFORME	COL				1.08	49				
TRACHELOMONAS	CEL					X				X
TRIBONEMA TRIAPPENDICULATA	CEL					X				
					2.11	99				
TOTAL				3717			4779			3192

LAKE NAME: STOCKTON RES.
STORET NUMBER: 2903

NYGAARD TROPHIC STATE INDICES

DATE	04 08 74	06 24 74	10 08 74
MYXOPHYCEAN	02/0 E	1.00 E	2.33 E
CHLOROPHYCEAN	04/0 E	5.00 E	3.67 E
EUGLENOPHYTE	0.17 ?	0.06 ?	0.28 E
DIATOM	0.87 E	0.67 E	0.80 E
COMPOUND	14/0 E	7.00 E	9.00 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	04 08 74	06 24 74	10 08 74
GENUS	06	05	03
SPECIES	05	04	00

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		04 08 74	06 24 74	10 08 74
AVERAGE DIVERSITY	H	1.38	2.82	3.19
NUMBER OF TAXA	S	28.00	34.00	41.00
NUMBER OF SAMPLES COMPOSITED	M	5.00	5.00	5.00
MAXIMUM DIVERSITY	MAXH	4.81	5.09	5.36
MINUMUM DIVERSITY	MINH	0.02	0.18	0.14
TOTAL DIVERSITY	D	29912.68	6443.70	11764.72
TOTAL NUMBER OF INDIVIDUALS/ML	N	21676.00	2285.00	3688.00
EVENESS COMPONENT	J	0.29	0.55	0.60
RELATIVE EVENESS	RJ	0.29	0.54	0.59
MEAN NUMBER OF INDIVIDUALS/TAXA	L	774.14	67.21	89.95
NUMBER/ML OF MOST ABUNDANT TAXON	K	16257.00	599.00	778.00

LAKE NAPA: STOCKTON RES.
STORET NUMBER: 2903

CONTINUED

TAXA	PGPH	04 08 74			06 24 74			10 08 74		
		IS	%C	ALGAL UNITS PER ML	IS	%C	ALGAL UNITS PER ML	IS	%C	ALGAL UNITS PER ML
ACHNANTHES MICROCEPHALA	CEL									X
ACTINASTRUM GRACILIMUM	CEL									X
ANKISTRODESMUS FALCATUS	CEL		1.80	387						
APHANIZOMENON	FIL									
ASTERIONELLA FORMOSA	CEL		0.60	129		2.44	54			
CERATIUM HIRUNDINELLA F. BRACHYCERAS	CEL						X			X
CERATIUM HIRUNDINELLA F. FURCOIDES	CEL						X			
CHLAMYDOMONAS	CEL			X						
CHROOMONAS ACUTA	CEL		2.40	430	14	16.71	381	33	20.21	744
CLOSTERIUM	CEL									X
CLOSTERIUM #1	CEL						X			
COELASTRUM MICROPORUM	COL									X
COELASTRUM RETICULATUM	COL						X			
COELASTRUM RETICULATUM V. POLYCHORDUM	COL						X			
COELASTRUM SPHAERICUM	COL						X			
COELOSPHAERIUM PALLIDUM	COL			X						
COSMARIUM CLEPSYDRA V. NANUM	CEL									X
CRUCIGENIA TETRAPEDIA	COL									X
CRYPTOMONAS	CEL	05	1.20	258	12	16.71	381	10	6.40	237
CRYPTOMONAS REFLEXA	CEL			X			X			
CYCLOTELLA MENEGHINIANA	CEL		0.40	86						
CYCLOTELLA STELLIGERA	CEL								1.80	68
CYMATOPLEURA SOLEA	CEL			X						
CYMBELLA	CEL			X						
CYST	CEL		0.20	43						
DACTYLOCOCCOPSIS	CEL								21.11	778
DINOBRYON DIVERGENS	CEL				05	2.44	54			
EUASTRUM	CEL						X			
EUASTRUM DENTICULATUM	CEL									X
EUGLENA #1	CEL									X
EUGLENA #2	CEL									X
EUGLENA SUBEHRENBERGII	CEL									X
FRAGILARIA CROTONENSIS	CEL				11	26.21	584			X
GLENODINIUM GYMNODINIUM V. BISCUTELLIFORME	CEL									
GLENODINIUM PENARIIFORME	CEL									X
KIRCHNERIELLA	CEL									X
LEPOCINCLIS	CEL						X			
LYNGBYA	CEL									X
MELOSIRA DISTANS	FIL								0.90	34
MELOSIRA GRANULATA	CEL	11	75.60	16257	13	19.11	436	12	15.01	575
MELOSIRA VARIANS	CEL	03	1.20	258			X	11	8.20	304
MERISMOPEDIA GLAUCA	CEL			X						
MERISMOPEDIA MINIMA	COL						X			
MERISMOPEDIA PUNCTATA	COL								0.90	34
MESOSTIGMA VIRIDIS	COL									X
MICROCYSTIS INCERTA	CEL						X			X
NAVICULA SALINARUM	COL						X		6.40	237
NITZSCHIA	CEL			X						
NITZSCHIA #1	CEL									
OOCYSTIS	CEL			X			X		0.90	34
OSCILLATORIA	FIL									
OSCILLATORIA #1	FIL		0.20	43						X
PANDORINA MORUM	COL			X						
PEDIASTRUM BIRADIATUM	COL						X			
PEDIASTRUM BIRADIATUM V. LONGECORNUTUM	COL									
PEDIASTRUM SIMPLEX	COL									X
PEDIASTRUM SIMPLEX V. DUPLEX ARTUM	COL						X			X
PENNATE DIATOM	CEL		0.60	129						
PHACUS	CEL									X
RAPHIDIOPSIS ?	FIL								6.40	237
SCENEDESMUS ABUNDANS	COL					2.44	54			
SCENEDESMUS ARCUATUS	COL						X			
SCENEDESMUS BICAULATUS	COL						X			
SCENEDESMUS DENTICULATUS V. LINEARIS	COL			X			X			X
SCENEDESMUS INTERMEDIUS	COL								0.90	34
SCENEDESMUS QUADRICAUDA	COL		0.20	43						X
SCENEDESMUS QUADRICAUDA V. QUADRISPINA	COL					2.44	54			
SKELETONEMA POTAMOS	CEL			X						
SPHAEROCYSTIS SCHROETERI	COL									X
STAURASTRUM	CEL						X			
STEPHANODISCUS ASTRAEA V. MINUTULA	CEL	12	14.90	3226				15	7.30	271
STEPHANODISCUS NIAGARAE	CEL	10	0.80	172						
SURIRELLA ANGUSTA	CEL			X						
SYNEDRA #1	CEL									X

Reproduced from best available copy.

LAKE NAME: STEERTON RES. CONTINUED
STORET NUMBER: 2903

TAXA	FORM	04 08 74 BS	04 08 74 EC	04 08 74 ALGAL UNITS PER ML	06 24 74 BS	06 24 74 EC	06 24 74 ALGAL UNITS PER ML	10 08 74 BS	10 08 74 EC	10 08 74 ALGAL UNITS PER ML
SYNEDRA #2	CEL								X	
SYNEDRA DELICATISSIMA V. ANGUSTISSIMA	CEL	1.00		215						
TETRAEDRON CONSTRICTUM	CEL					X				
TETRAEDRON GRACILE	CEL								X	
TETRAEDRON MINIMUM	CEL				7.11	163				
TETRAEDRON MINIMUM V. SCHROEDERIANUM	CEL							2.78	101	
TETRASTRUM STAUROGENIAEFORME	COL		X							
TRACHELOMONAS	CEL					X				
TRACHELOMONAS HISPIDA	CEL		X							
TREUBARIA SETIGERUM	CEL				4.00	109				
TOTAL				21676		2285				3600

LAKE NAME: LAKE TANEYCOMO
STORET NUMBER: 2904

NYGAARD TROPHIC STATE INDICES

DATE	04 10 74	06 19 74	08 30 74	10 04 74
MYXOPHYCEAN	0/0 D	02/0 E	04/0 E	0.50 E
CHLOROPHYCEAN	0/0 D	04/0 E	03/0 E	1.50 E
EUGLENOPHYTE	0/0 ?	0/06 ?	0.29 E	0/04 ?
DIATOM	0.44 E	0.36 E	0.50 E	0.50 E
COMPOUND	04/0 E	10/0 E	13/0 E	3.50 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	04 10 74	06 19 74	08 30 74	10 04 74
GENUS	03	04	01	01
SPECIES	00	01	00	02

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		04 10 74	06 19 74	08 30 74	10 04 74
AVERAGE DIVERSITY	H	2.10	3.06	2.99	1.03
NUMBER OF TAXA	S	16.00	27.00	28.00	17.00
NUMBER OF SAMPLES COMPOSITED	M	2.00	2.00	2.00	2.00
MAXIMUM DIVERSITY	MAXH	4.00	4.75	4.81	4.09
MINUMUM DIVERSITY	MINH	0.12	0.44	0.34	0.07
TOTAL DIVERSITY	D	3066.00	1943.10	2682.03	3065.28
TOTAL NUMBER OF INDIVIDUALS/ML	N	1460.00	635.00	897.00	2976.00
EVENESS COMPONENT	J	0.53	0.64	0.62	0.25
RELATIVE EVENESS	RJ	0.52	0.61	0.60	0.24
MEAN NUMBER OF INDIVIDUALS/TAXA	L	91.25	23.52	32.04	175.06
NUMBER/ML OF MOST ABUNDANT TAXON	K	625.00	127.00	179.00	2486.00

LAKE NAME: LAKE TAHEYCHO CONTINUED
STORET NUMBER: 2904

TAXA	FORM	04 16 74 BS	04 16 74 CC	04 16 74 ALGAL UNITS PER ML	06 19 74 BS	06 19 74 CC	06 19 74 ALGAL UNITS PER ML	08 30 74 BS	08 30 74 CC	08 30 74 ALGAL UNITS PER ML	10 04 74 BS	10 04 74 CC	10 04 74 ALGAL UNITS PER ML
ACHNANTHES MICROCEPHALA	CEL						X	114.91		134	183.51		2486
ANABAENA	FIL									X			
ASTERIONELLA FORMOSA	CEL			X			X						
CERATIUM HIRUNDINELLA F. BRACHYCERAS	CEL									X			
CHLAMYDOMONAS	CEL									X			
CHROOMONAS ACUTA	CEL			X	120.01		127			X	4.11		122
COCCONEIS	CEL			X			X	5.01		45			X
COSMARIUM	CEL										1.41		41
CRYPTOMONAS	CEL	151	0.61	125									
CRYPTOMONAS EROSA	CEL				121	0.61	42	110.01		90	5.51		163
CRYPTOMONAS REFLEXA	CEL									X			
CYCLOTELLA	CEL				133	3.41	85						
CYMBELLA #1	CEL						X			X			X
CYMBELLA #2	CEL												X
CYMBELLA #3	CEL						X						
DACTYLOCOCCOPSIS	CEL									X			
DIATOMA VULGARE	CEL		2.91	42			X			X			X
DICTYOSPHAERIUM	COL						X						
DINOBRYON BAVARICUM	CEL							120.01		179			
DINOBRYON SOCIALE	CEL				133	3.41	85						
EUGLENA	CEL									X			
FLAGELLATE #2	CEL						X						
FRAGILARIA CROTONENSIS	CEL		2.91	42			X						
GLENODINIUM ACICULIFERUM	CEL							5.01		45			
GOMPHONEMA OLIVACEUM	CEL			X			X						
GYMNODINIUM	CEL	141	2.91	42									
GYROSIGMA	CEL						X						
KIRCHNERIELLA	CEL							120.01		179			
LYNGBYA	FIL						42				1.41		41
MELOSIRA	CEL	133	31.41	459									
MELOSIRA DISTANS	CEL			X			X	110.01		90			
MELOSIRA GRANULATA	CEL							5.01		45			X
MELOSIRA GRANULATA V. ANGUSTISSIMA	CEL						X						
MELOSIRA VARIANS	CEL			X						X	2.81		82
MICROCYSTIS INCERTA	COL						42						
NAVICULA #1	CEL			X									X
NAVICULA #2	CEL			X						X			
NITZSCHIA	CEL									X			
NITZSCHIA ACICULARIS	CEL				141	3.41	85						
NITZSCHIA FILIFORMIS	CEL									X			
OSCILLATORIA	FIL									X			
PERIDINIUM ACICULIFERUM ?	CEL						X						
PERIDINIUM QUADRIDENS	CEL						X						
PHACUS ACUMINATUS	CEL									X			
RAPHIDIOPSIS CURVATA	CEL							110.01		90			
SCENEDESMUS DENTICULATUS V. LINEARIS	COL						X			X			
SCENEDESMUS QUADRICAUDA	COL				151	0.61	42						X
STAURASTRUM	CEL										1.41		41
STEPHANODISCUS	CEL	133	42.61	625			X			X			X
SURIRELLA	CEL						X						
SYNEDRA	CEL									X			
SYNEDRA DELICATISSIMA V. ANGUSTISSIMA	CEL	121	8.61	125									
SYNEDRA ULNA	CEL			X									
TETRAEDRON MINIMUM V. SCROBICULATUM	CEL				133	3.41	85			X			X
TETRAEDRON TRIGONUM V. PAPILLIFERUM	CEL												X
TOTAL				1460			635			897			2976

Reproduced from best available copy.

LAKE NAME: THOMAS MILL RES.
STORET NUMBER: 2905

NYGAARD TROPHIC STATE INDICES

DATE	04 08 74	06 20 74	10 07 74
MYXOPHYCEAN	1.00 E	0.50 E	1.50 E
CHLOROPHYCEAN	2.00 E	0.50 E	5.50 E
EUGLENOPHYTE	1.67 E	0.50 E	0.71 E
DIATOM	1.00 E	2.00 E	1.00 E
COMPOUND	10.0 E	2.50 E	14.5 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	04 08 74	06 20 74	10 07 74
GENUS	00	01	19
SPECIES	00	00	03

SPECIES DIVERSITY AND ABUNDANCE INDICES

		DATE	04 08 74	06 20 74	10 07 74
AVERAGE DIVERSITY	H		1.91	2.16	3.01
NUMBER OF TAXA	S		15.00	12.00	42.00
NUMBER OF SAMPLES COMPOSITED	M		3.00	3.00	3.00
MAXIMUM DIVERSITY	MAXH		3.91	3.58	5.39
MINIMUM DIVERSITY	MINH		0.37	0.13	0.10
TOTAL DIVERSITY	D		716.25	2004.48	18177.39
TOTAL NUMBER OF INDIVIDUALS/ML	N		375.00	928.00	6039.00
EVENESS COMPONENT	J		0.49	0.60	0.56
RELATIVE EVENESS	RJ		0.44	0.59	0.56
MEAN NUMBER OF INDIVIDUALS/TAXA	L		25.00	77.33	143.79
NUMBER/ML OF MOST ABUNDANT TAXON	K		140.00	253.00	2045.00

LAKE NAME: THOMAS MILL RES. CONTINUED
STORET NUMBER: 2905

TAXA	FORM	04 08 74 BS	04 08 74 %C	04 08 74 ALGAL UNITS PER ML	06 20 74 BS	06 20 74 %C	06 20 74 ALGAL UNITS PER ML	10 07 74 BS	10 07 74 %C	10 07 74 ALGAL UNITS PER ML
ANABAENA	FIL									X
ANKISTRODESMUS FALCATUS	CEL						X		2.48	146
APHANIZOMENON FLOS-AQUAE	FIL									X
CERATIUM HIRUNDINELLA F. BRACHYCERAS	CEL								0.88	49
CHLAMYDOMONAS	CEL						X		3.21	195
CHLOROGONIUM	CEL									X
CHROOMONAS ACUTA	CEL	12	37.31	140	12	27.31	253		5.68	341
CLOSTERIUM	CEL						X		0.88	49
CLOSTERIUM #1	CEL				15	4.55	42			
CLOSTERIUM #2	CFL			X						X
COELASTRUM MICROPORUM	COL									X
CRUCIGENIA QUADRATA	COL			X						
CRYPTOMONAS	CEL				13	22.71	211			
CRYPTOMONAS EROSA	CEL	13	25.11	94			X		1.68	97
DICTYOSPHAERIUM PULCHELLUM	COL								1.68	97
EUGLENA	CEL									X
EUGLENA #1	CEL			X				15	1.68	97
EUGLENA OXYURIS V. MINOR	CFL									X
EUGLENA SUBEHRENBERGII ?	CEL									X
FRAGILARIA CROTONENSIS	CEL			X						
FRANCEIA	CEL									X
GLENODINIUM OCULATUM	CEL									X
GOMPHOSPHAERIA	COL									X
GYROSIGMA	CEL						X			X
HIRCHNERIELLA LUNARIS	CFL									X
LEPOCINCLIS	CEL									X
MELOSIRA DISTANS	CEL			X	14	16.21	369	13	11.31	682
MELOSIRA GRANULATA	CEL									X
MELOSIRA GRANULATA V. ANGUSTISSIMA	CEL									X
NITZSCHIA	CEL	14	12.51	47						X
NITZSCHIA #1	CFL							14	20.21	1217
NITZSCHIA TRYBLIONELLA V. DEBILIS	CEL									X
OSCILLATORIA	FIL						X			
OSCILLATORIA #1	FIL			X						
PHACUS	CEL			X						
PHACUS #1	CEL									X
PHACUS MEGALOPSIS	CEL			X						X
SCENEDESMUS DENTICULATUS	COL									X
SCENEDESMUS DIMORPHUS	COL									X
SCENEDESMUS INTERMEDIUS	COL								0.88	49
SCENEDESMUS QUADRICAUDA	COL								0.88	49
SCHROEDERIA SETIGERA	CEL	13	25.11	94						
SKELETONEMA POTAMOS	CEL							12	11.31	682
STEPHANODISCUS	CEL			X						
STEPHANODISCUS ASTRAEA V. MINUTULA	CEL				11	27.31	253	11	33.91	2045
SYNEDRA	CEL								0.88	49
TETRAEDRON CONSTRICTUM	CEL									X
TETRAEDRON PUTICUM	CEL								0.88	49
TRACHELOMONAS	CFL			X					1.68	97
TRACHELOMONAS INTERMEDIA	CFL			X			X			X
TRACHELOMONAS VOLVOCINA	CEL								0.88	49
TOTAL				375			928			6039

Reproduced from best available copy.

LAKE NAME: HAPPEPELLO RES.
STORET NUMBER: 2906

NYGAARD TROPHIC STATE INDICES

DATE	04 09 74	06 18 74	10 08 74
MYXOPHYCEAN	04/0 E	3.50 E	2.50 E
CHLOROPHYCEAN	06/0 E	8.00 E	3.00 E
EUGLENOPHYTE	0.40 E	0.22 E	0.64 E
DIATOM	0.27 ?	0.70 E	0.80 E
COMPOUND	17/0 E	17.5 E	11.0 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	04 09 74	06 18 74	10 08 74
GENUS	10	19	07
SPECIES	00	03	07

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		04 09 74	06 18 74	10 08 74
AVERAGE DIVERSITY	H	3.59	4.34	1.63
NUMBER OF TAXA	S	35.00	62.00	32.00
NUMBER OF SAMPLES COMPOSITED	R	4.00	4.00	4.00
MAXIMUM DIVERSITY	MAXH	5.13	5.95	5.00
MINUMUM DIVERSITY	MINH	0.11	0.15	0.09
TOTAL DIVERSITY	D	14517.96	24833.48	7683.82
TOTAL NUMBER OF INDIVIDUALS/ML	N	4044.00	5722.00	4714.00
EVENESS COMPONENT	J	0.70	0.73	0.33
RELATIVE EVENESS	RJ	0.70	0.73	0.32
MEAN NUMBER OF INDIVIDUALS/TAXA	L	115.54	92.29	147.31
NUMBER/ML OF MOST ABUNDANT TAXON	K	967.00	786.00	3341.00

LAKE NAME: RAFFERTY RES. CONTINUED
STORET NUMBER: 2906

TAXA	FORM	09 09 74 IS	09 09 74 SC	09 09 74 ALGAL UNITS PER ML	26 10 74 IS	26 10 74 SC	26 10 74 ALGAL UNITS PER ML	30 08 74 IS	30 08 74 SC	30 08 74 ALGAL UNITS PER ML
ACHNANTHES MICROCEPHALA	CEL		3.33	132						
ANABAENA	FIL						X			
ANKISTRODESMUS FALCATUS	CEL					1.23	67			
ANKISTRODESMUS FALCATUS V. ACICULARIS	CEL					0.82	45			
ANKISTRODESMUS FALCATUS V. MIRABILIS	CEL			X					3.83	179
APHANIZOMENON FLOS-AQUAE	FIL			X						
APHANOTHECE	COL					0.41	22			
ASTERIONELLA FORMOSA	CEL		2.23	88		0.41	22			
ASTERIONELLA FORMOSA V. GRACILLIMA	CEL						X			
CAPTERIA	CEL					0.82	45			
CENTRIC DIATOM	CEL					3.13	180			X
CERATIUM HIRUNDINELLA F. BRACHYCERAS	CEL									X
CERATIUM HIRUNDINELLA F. FURCOIDES	CEL						X			
CHLAMYDOMONAS	CEL			X						
CHLOROPHYTAN FILAMENT	FIL						X			
CHROOMONAS ACUTA	CEL		11.91	463	13	13.1	741			
CLOSTERIUM	CEL						X			
CLOSTERIUM #1	CEL									X
CLOSTERIUM #2	CEL						X			
COELASTRUM MICROPORUM	COL					1.64	90			
COELASTRUM RETICULATUM	COL						X			
COELASTRUM SPHAERICUM	COL					0.82	45			
CRUCIGENIA QUADRATA	COL			X						
CRUCIGENIA TETRAPEDIA	COL					0.82	45	148	5.13	239
CRYPTOMONAS EROSA	CEL	121	9.81	395		3.49	225	458	2.56	119
CRYPTOMONAS REFLEXA	CEL	458	2.23	88		0.41	22			
CYANOPHYTAN FILAMENT	FIL									X
CYCLOTELLA	CEL					2.05	112			
CYCLOTELLA STELLIGERA	CEL									X
CYMBELLA	CEL					0.41	22			
CYMBELLA #1	CEL			X						
DACTYLOCOCCOPSIS	CEL		5.46	220		4.31	247			
DICTYOSPHAERIUM	COL			X						
DINOBRYON BAVARICUM	CEL					0.41	22			
DINOBRYON DIVERGENS	CEL				458	5.54	314			
DINOFLAGELLATE CYST	CEL					0.82	45			
EUASTRUM DENTICULATUM	CEL									X
EUGLENA	CEL	138	3.33	132						
EUGLENA #1	CEL					1.23	67			
EUGLENA ACUS	CEL						X			X
EUGLENA EHRENBERGII	CEL									X
EUGLENA GRACILIS	CEL									X
EUGLENA TRIPTERIS	CEL									X
FLAGELLATE #2	CEL		3.33	132		1.23	67			
FRAGILARIA CROTONENSIS	CEL					2.05	112			X
GLENODINIUM	CEL						X			
GOMPHONEMA	CEL			X						
GYMNODINIUM ALBULUM	CEL						X			
GYROSIGMA	CEL			X			X			
LAGERHEIMIA CHODATI ?	CEL						X			
LEPOCINCLIS	CEL		2.23	88						
LUNATE CELL	CEL					0.82	45			
LYNGBYA	FIL						X			
MELOSIRA DISTANS	CEL	11	23.9	967	11	13.7	786	11	70.4	3341
MELOSIRA GRANULATA	CEL	241	9.46	620	121	8.61	494	121	8.91	418
MELOSIRA GRANULATA V. ANGUSTISSIMA	CEL		8.71	352		3.58	202			
MELOSIRA VARIANS	CEL						X			
MERIDION CIRCULARE	CEL		1.11	44						
MERISMOPEDIA MINIMA	COL					2.46	135			
MESOSTIGMA VIRIDIS	CEL		1.11	44		0.41	22			
MICROCYSTIS AERUGINOSA	COL									X
MICROCYSTIS INCERTA	COL		1.11	44		8.21	472			
NAVICULA	CEL						X			
NAVICULA #1	CEL		1.11	44						
NAVICULA #2	CEL			X						
NITZSCHIA	CEL						X			X
NITZSCHIA ?	CEL						X			
NITZSCHIA #1	CEL			X		2.10	112			
NITZSCHIA #2	CEL			X						
NITZSCHIA #3	CEL									X
NITZSCHIA SPP.	CEL		11.91	483						
OOCYSTIS	COL					0.82	45			
OSCILLATORIA	FIL			X						
OSCILLATORIA ?	FIL									X
OSCILLATORIA LIMNETICA	FIL						X			X
PANDORINA	COL					0.41	22			
PANDORINA MORUM	COL									X
PEDIASTRUM DUPLEX V. ?	COL									X

Reproduced from best available copy.

LAKE NAME: WAPPEPELLO RES.
STUDY NUMBER: 2906

CONTINUED

TAXA	FORM	04 09 74 US	04 09 74 SC	04 09 74 ALGAL UNITS PER ML	06 18 74 US	06 18 74 SC	06 18 74 ALGAL UNITS PER ML	10 08 74 US	10 08 74 SC	10 08 74 ALGAL UNITS PER ML
PEDIASTRUM DUPLEX										
V. RETICULATUM	COL					X				
PEDIASTRUM TETRAS										
V. TETRAODON	COL					X				
PHACUS CURVICAUDA	CEL					X			X	
PHACUS MEGALOPSIS	CEL		X						X	
RAPHIDIOPSIS CURVATA	FIL								X	
SCENEDESMUS BIJUGA	COL				1.20	67				
SCENEDESMUS DENTICULATUS	COL					X				
SCENEDESMUS DIMORPHUS	COL				0.40	22				
SCENEDESMUS QUADRICAUDA	COL		X		0.40	22		1.30	60	
SCHROEDERIA SETIGERA	CEL	1.30	44		0.80	45				
SKELETONEMA POTAMUS	CEL			141	9.00	502				
SURIRELLA	CEL								X	
SYNEDRA	CEL	1.30	44							
SYNEDRA ACUS	CEL				1.60	90				
SYNEDRA ULNA	CEL								X	
TETRAEDRON LIMNETICUM	CEL		X							
TETRAEDRON MINIMUM										
V. SCROBICULATUM	CEL							2.60	119	
TETRAEDRON TRIGONUM										
V. GRACILE	CEL					X			X	
TRACHELOMONAS	CEL					X				
TRACHELOMONAS INTERMEDIA	CEL		X					5.20	239	
TRACHELOMONAS JACULATA	CEL				0.40	22				
TOTAL				4144		5722			4734	

B379

United States
Environmental Protection
Agency

Environmental Research
Information Center
Cincinnati OH 45268

Official Business
Penalty for Private Use
$300

Postage and
Fees Paid
Environmental
Protection
Agency
EPA 335

Special Four
Class Rate
Book

If your address is incorrect, please change on the above label, tear off, and return to the above address.
If you do not desire to continue receiving this technical report series, CHECK HERE ☐, tear off label, and return it to the above address.

EPA 600 3 79 065